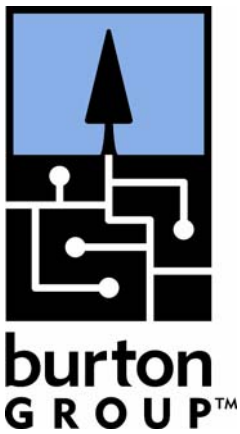

Voice over IP (VoIP) Product Strategy

Project Report

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Presented To

GEORGIA TECHNOLOGY AUTHORITY

Presented By

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1 Executive Summary

The purpose of this document is as follows:

(1) to describe the voice services consulting project executed by Burton Group for the Georgia Technology Authority (GTA);

(2) to document the size, distribution, operating environments and business requirements of customer profiles for a voice product strategy;

(3) to document the product strategy alternatives available to the GTA for a voice-over-IP based product strategy and related industry best practices;

(3) to present and rationalize a product strategy recommendation.

The document describes the initial phase of the project; definition and development of a three to seven year product strategy for voice-over-IP (VoIP) based services. In developing this strategy, Burton Group relied on inputs received from the core product team comprised of key members of the GTA team and its customers within the State of Georgia, as well as consideration of industry trends, best practices, and emerging standards activities. The resulting strategy leverages the GTA's current MPLS-based data network deployment initiative and is based on four end-user customer scenarios selected as representative examples of the GTA's addressable market for its new VoIP-based products and services.

The GTA has multiple potential product strategies available for deployment including both premises-based and network-based solutions. In an effort to minimize capital, operational, and recurring maintenance costs while achieving its goal of building a communications framework which will enable state agencies to meet their own unique business requirements and improve their ability to serve their constituents, Burton Group recommends that the GTA adopt a voice product strategy based on a hybrid IP-PBX system architecture deployed within a hosted implementation model. A hybrid IP-PBX environment offers the GTA the flexibility to offer voice-over-IP services utilizing analog, digital, or IP phone devices, and supports the optional convergence of LAN environments as deemed appropriate by its customers within the State of Georgia. The premise-based solutions currently used by the state agencies vary significantly in their life cycle stage, therefore it is reasonable to assume that any new voice service will have an extended migration timeline, a period ten (10) years is a reasonable assumption.

Different triggers for different agencies will determine the migration from the current agency voice environments to the new voice product strategy, the first of which will be new facility construction. The next "user" scenario that will lead to a migration is those agency locations which have decided to use a non-PSTN voice solution to meet their voice services needs and those agency locations with existing legacy PBX and KTS systems that are nearing the end of their life cycle. The next requirements that can best be met with the new product strategy will be those agencies have a critical or growing requirements for increased mobility in order to better serve their agency constituents along with growing requirement for supporting tele-worker applications. The implementation of video-based applications and enhanced communications applications such as instant messaging platforms, presence-based tools will be enabled by a VoIP product strategy and will improve the efficiency and operations of these agencies and will therefore provide applications value that will encourage migration. The remaining addressable market, traditional Centrex™ users with basic feature and function requirements, will migrate based on operational cost reductions due to lower monthly recurring costs and the phased elimination of peripheral cost impacts such as LAN upgrades due to other project initiatives.

The end solution as a result of this product strategy may be hosted at state-owned facilities and managed by the GTA, hosted by the GTA and managed by a third-party (e.g. EDS, IBM or Unisys), or hosted and managed exclusively by a third-party at a carrier-class co-location or data center facility.

The following sections are organized to first present the current situation relative to the voice services managed by the GTA, a description of the overall voice services project which Burton Group is assisting the GTA with, a description of the target market profiles identified for use of the new voice-over-IP-based services, a review of the alternative approaches to providing these new services, and Burton Group's recommendation on how the GTA should proceed from a product strategy perspective. Lastly, Appendix A provides a summary view of the profiles operating environments and requirements and how each alternative product approach is positioning to meet the needs of each identified profile.

2 Situation Analysis

The Georgia Technology Authority (GTA) provides telecommunications services to state government agencies and universities across the State of Georgia. Its current voice services environment varies from both agency to agency as well as location to location. The voice services it provides primarily consists of a combination of local exchange carrier (LEC) network-provided Centrex™ services, private branch exchange (PBX) and key telephone system (KTS) premise-based solutions with individual business line or primary rate ISDN (PRI) network connections.

The GTA currently manages this widely distributed, statewide voice communications network consisting of approximately one-hundred and sixty-eight thousand (168,000) Centrex™ lines, twenty-four (24) PBXs, seven-hundred (700) KTS, and sixty-nine thousand (69,000) voice mail boxes delivered by fifty-six (56) Centigram systems which all connect to the public switched telephone network (PSTN) through thirty-two (32) different LECs and eleven (11) central-office based voice mail services. The GTA and the state agencies it serves are under increasing pressure to reduce telecommunications costs and therefore the GTA has initiated a project to investigate the use of voice-over-IP (VoIP) based technology to achieve lower operating costs and increase communications efficiencies. While the GTA manages telecommunications and wide area network (WAN) services, each state agency operates and manages its own local area network (LAN) environment. In addition, while the current demarcation point for data and voice services are not the same, migration to a converged IP-based voice and data solution will require agencies and the GTA to reach mutually agreed upon standards and procedures for management of the demarcation point.

3 Project Overview

The following sections provide an overview of the purpose and scope of the full consulting engagement between the GTA and Burton Group and a review of the project methodology executed during the initial phase of the project.

3.1 Purpose and Scope

The purpose of the voice services consulting project with the GTA is as follows:

(1) *to provide assistance to the GTA in its strategic efforts to define, develop, and document a three to seven year product strategy for voice-over-IP based voice services,*

(2) to develop product positioning statements which provide an analysis of the alternatives available to the GTA's customers and document the relative value of the new voice-over-IP based voice services,

(3) to develop a business case (return on investment) analysis for the GTA for a voice-over-IP based solution with an accompanying end-user cost analysis,

(4) to develop a document which details the product requirements that the GTA can leverage within its procurement process for a voice-over-IP based solution,

(5) to provide the GTA with an independent evaluation of vendor responses received during the procurement process for a voice-over-IP based solution.

The final result of this voice services consulting project for the GTA will ensure that the product strategies, financial modeling, and product requirements used to select infrastructure elements over a tactical and strategic planning period are viable, credible, and reflect current industry best practices.

3.2 Project Methodology

The first phase of the consulting engagement was focused on the development of a voice-over-IP based product strategy which will be used as a foundation for the development of the product positioning and solution requirements deliverables.

The second phase of the project will be executed in two components utilizing a staggered, parallel approach. The project activities associated with the product positioning and value proposition statement document will start immediately

following the review and acceptance of the product strategy document by the GTA. The business case development and end-user cost analysis will be initiated once the initial product positioning and value propositions have been defined.

The combination of the first and second phase deliverables will form the strategic inputs into the third phase, the assembly and development of a product requirements document to be utilized by GTA during its procurement process. The fourth and final phase of the project will be to assist the GTA in the evaluation and scoring of vendor responses received during the procurement process. Each of the phases is described in greater detail below.

Phase 1 - Develop Product Strategy

The initial phase of the project is the definition and development of a three to seven-year product strategy for voice-over-IP based services. The product strategy has been derived from industry trends, best practices, standards activities, and inputs from the core product team comprised of key members of the GTA team and its customers within the State of Georgia. The product strategy identifies potential product entry strategies for GTA and the evolutionary roadmap for each entry strategy. The resulting strategy leverages the GTA's current MPLS network deployment initiative and has been developed given four (4) end-user customer scenarios selected as representative scenarios of the GTA's addressable market for its new voice-over-IP based services.

Based on the four (4) customer profiles prepared by GTA staff, an initial product strategy meeting was conducted with the product team at GTA facilities in Atlanta, GA on March 31 through April 1, 2004. The meeting was focused on reviewing the four (4) customer profiles, discussing the business requirements for voice (and converged) communications, and discussing potential product strategies which could address the voice services needs of the GTA's customers. The project deliverable from this initial phase is a product strategy document (this document). The document reflects the inputs, comments, and corrections obtained from the product team during the review of the draft report conducted at GTA facilities on April 28, 2005.

Phase 2A - Develop Product Positioning and Value Proposition

The second phase of the consulting engagement includes two components, the first of which is the development of a product positioning document which includes the value proposition to the GTA's customers for its new voice-over-IP product. The primary purpose of the positioning document will be to provide an analysis of the alternatives available to the GTA's customers and to document

the positioning of a relative value proposition to meet the range of needs that the GTA must serve.

Phase 2B - Develop Total Cost of Ownership (TCO) Analysis Models

The second component of the this phase will be the development of a business case (total cost of ownership) analysis model for the GTA for a voice-over-IP based solution with an accompanying end-user cost analysis. The cost analysis will not only be based on the new voice-over-IP based services provided by the GTA, but will also include reasonable estimates for end-users to voice-enable their existing local area network (LAN) environments and acquire new desktop phones and software (soft phone) client licenses.

Phase 3 – Develop Detailed Solutions Requirements for Request for Proposal

The third phase of the consulting engagement will be driven by the deliverables obtained from Phase 1 and Phase 2 of this project as well as the baseline of current voice requirements provided by the GTA team. Given this information, a document will be developed which details the product requirements that the GTA can utilize and leverage as the requirements component of its procurement process. The requirements to be included in the document will include, but will not necessarily be limited to: phone system features currently in use by GTA customers, voice-over-IP enablement of local area networks, communications applications and services, mobility, security, performance, availability, system and call management requirements, voice services to remote offices, and project management and implementation capabilities.

Phase 4 - Evaluate/Score Vendor Responses from Request for Proposal

The fourth and final phase of the consulting engagement will provide the GTA with an independent evaluation of vendor responses received by the GTA during its procurement process. Within this deliverable, individual vendor response summary documents and evaluation matrices will be developed. In addition,, a high-level cost analysis for each solution will be completed and vendor market positions and long-term outlooks will be compared. In addition to the written assessment of the proposal responses, Burton Group will provide its observations related to the operational and organizational implementation considerations with each vendor response. Lastly, Burton Group will provide a specific recommendation to the GTA for its award of contract.

4 Customer Profile Descriptions

The initial step to defining and rationalizing a voice-over-IP voice strategy for the GTA is to define the target market. The definition of the target market requires and understanding of the operating environment, the business drivers, and future communications requirements of representative market segments within the target market.

In an effort to scope the market definition activity, the GTA identified four (4) target market customer profiles. The profiles, based on representative state agencies, were selected to provide a representative sample of the breadth of telecommunications operating environments, usage patterns, size and distribution of agency office locations, mobility, modernization of contact center environments, and application integration requirements that exist with the agencies served by the GTA.

While not created to exactly duplicate and mirror the specific requirements of each individual agency, the following profiles are intended to provide each agency with the opportunity to understand the various business, technical, and cultural considerations involved in the development of the product strategy and that it encompasses the breadth of multiple dynamics that are inherent in each agency's organization.

The first example customer profile, "Agency A", primarily utilizes Centrex™ voice services with a limited number of PBX systems in key locations. The agency operates in a very high number of office locations, with a high variance in the number of staff within each location, and is widely distributed across the State of Georgia. "Agency A" is seeking a solution or set of solutions that can enable efficient, mobile workers and leverage current technology to integrate existing applications with communications to improve and enhance constituent service levels. The agency may obtain increased levels of federal funding for initiatives that can be directly tied to increased efficiencies related to delivering constituent programs and services.

The location scalability and distribution requirements for "Agency B" differ considerably from "Agency A". "Agency B" has a comparatively modest number of physical locations but those locations are evenly divided between branch offices and campus environments. The agency also has a strong interest in extending current voice communication services to enable mobility across the campus environments and has a strong ability to access capital funding.

The third profile, "Agency C" also has a comparatively modest number of physical office locations but also utilize contact center and data center operations and has an interest in the potential extensibility of a voice communications platform to local government agencies with a similar mission. "Agency C" has a higher level of intra-agency, site-to-site calling usage that the previously described agency profiles and has a high requirement for information and communications security.

"Agency D" represents a profile that contains a mixture of the operating environments and business requirements contained in the other three profiles. The agency predominantly utilizes Centrex™ services and has similar scalability and site distribution requirements of "Agency C". "Agency D" shares the need to provide enhanced support for mobility applications with "Agency B" with usage and call patterns that mirror "Agency C". In addition, the agency maintains both call center and data center operations similar to "Agency C".

The example customer profiles, described in greater detail below, have been developed to provide state agencies with a perspective on the shared and unique business requirements, operating environments, and technical considerations that exist amongst the profiles. In addition, a tabular, summary comparison of the operating environments and business requirements of each of these profiles is included in Appendix A.

4.1 Customer Profile "Agency A"

4.1.1 Size and Workforce Distribution

The first customer reference model, subsequently referred to as "Agency A", is organized into multiple divisions and program offices. The agency staff totals more than twenty-thousand (20,000) and is distributed statewide across more than eight-hundred (800) facilities including headquarters, regional offices, local offices, and several customer contact centers. In addition, approximately 500 of the agency's workforce interacts with constituents outside of agency-maintained facilities and therefore may be considered "mobile" workers.

4.1.2 Current Voice Network Operating Environment

The current voice network utilized to support "Agency A" consists of voice "islands" served by a combination of network-based local exchange carrier (LEC) Centrex™ services, LEC-provided flat-rate business line services, premise-based

private branch exchange (PBX) systems. The agency utilizes Centrex™ services within the majority of its headquarters, regional, and local offices although approximately six (6) regional facilities are served by on-premise PBX systems with auxiliary power generator support. In addition to standard Centrex™ features and functionality, the agency's customer contact centers utilize uniform call distribution (UCD) functions for the efficient routing and distribution of inbound calls to its call center agents.

The agency has a low demand for intra-agency site-site voice communications, the calling patterns consist primarily of local inbound and outbound, a high level of inter-LATA toll usage within regional and local offices, and toll-free inbound access to its call center facilities. The agency's sites are currently networked solely via the public switched telephone network (PSTN) from a voice services perspective. The majority of its facilities are equipped with uninterruptible power supplies (UPS) while regional and headquarters offices are equipped with UPS and external power generator capabilities.

The agency primarily utilizes analog handsets in conjunction with these voice services and systems but also uses proprietary, legacy digital phone handsets in some administrative locations. The agency's voice mail requirements are met by a combination of premise-based Centigram™ voice mail systems and network-based BellSouth voice mail services. In addition to the communications services provided to it facilities statewide, "Agency A" utilizes a combination of state paging, public cellular voice, and handheld wireless data services to meet its wireless communication needs.

4.1.3 Current Data Network Operating Environment

The wiring infrastructure for the agency's local area network (LAN) environment consists primarily of category 3 (CAT3) cable plant with some category 5 (CAT5) wired connections. The agency has deployed a very limited number of wireless access points for wireless LAN (WLAN) connectivity. The current LAN switch infrastructure, sourced from Cabletron/Enterasys, is five (5) or more years into its lifecycle and is not slated to be refreshed at this time. The existing switch infrastructure is unable to support applications that require standards-based LAN functionality such as power-over-Ethernet (PoE) or quality of service (QoS).

The agency's wide area network (WAN) environment consists of a mixture of frame relay, multi-protocol label switching (MPLS), and a limited amount of system network architecture (SNA) connections. The agency is currently migrating its current frame relay data service connections to the State of Georgia's new MPLS service provided by BellSouth. The connection speeds

from each site to the MPLS network are expected to vary from 1.5 to 10 Mbps. The agency maintains data stores of protected information it obtains from and utilizes on behalf of its constituents, therefore information security is high priority and the agency utilizes firewall and encryption technologies to protect these "islands of information" from unauthorized network access and activity. Lastly, the agency's standard computing (desktop and laptop) environment is based on the Microsoft Windows™ XP operating system and utilizes Novell's GroupWise™ as its standard e-mail application.

4.1.4 Business Drivers and Requirements

The challenge of supporting an expanding number of programs and constituents with limited government funding constraints is a common issue across state governments today. The ideal voice communications solution or solutions for "Agency A" will directly reduce operating costs and improve efficiencies while delivering better service to its constituents. The agency can realize these cost reductions though one of or a combination of the following: reduced costs to manage, maintain, and support voice services, reduced connectivity costs, or reduced usage costs.

With respect to improved efficiencies, the integration of voice communications with other applications can improve the efficiency at which the agency communicates with its constituents, i.e. a proactive audio-based communication to update citizens on the status of an approval or financial transaction. In addition, this example can contribute to lowering operating costs by reducing the volume of inbound calls to agency contact centers and raising overall customer (constituent) satisfaction. The agency may also improve operational efficiencies by evolving the accessibility and integration of its communications environment for its workforce. The agency's staff may leverage video-based technologies to more efficiently meet with constituents in office and mobile environments. In addition to the appropriated funding the agency receives at the state-level, the agency receives a funding contribution by the federal government. The agency can obtain accelerated levels of federal funds based on its ability to provide more efficient and expanded services to its constituents.

Although "Agency A" has not deployed and significant levels of WLAN technology for its internal use, the agency is experiencing demand from its constituents to enable wireless access for them within "Agency A" offices. In addition, the agency is experiencing increased levels of interest from its workers to enable mobile, occasional, and permanent tele-worker work environments.

The customer contact centers operated by "Agency A" may also take advantage of the new voice communications solutions. The agency may elect to evolve to a distributed contact center environment utilizing "virtual" agents, flexible staff models, increased computer telephony integration (CTI) and self-help services. The shift to such an environment has the potential for significant cost savings as well as improving call routing intelligence using presence technologies.

4.2 Customer Profile "Agency B"

4.2.1 Size and Workforce Distribution

The second of four customer profile reference models, "Agency B", is distributed across the State of Georgia with a headquarters facility and more than thirty (30) regional campus environments, and an additional thirty (30) branch offices. The agency is staffed by more than six-thousand (6,000) employees providing services to over thirty-thousand (30,000) citizens of the State of Georgia.

4.2.2 Current Voice Network Operating Environment

The agency's voice network consists of voice "islands" served by a combination of LEC-provided Centrex™ services, LEC-provided flat-rate business line services, and premise-based PBX and KTS systems. The regional campus sites are served utilizing approximately eighty-percent (80%) Centrex™ services and twenty-percent (20%) PBX and IP-PBX systems. With the few IP-PBX systems it has deployed, the agency has achieved some initial experience with VoIP-based solutions. The branch or satellite campuses utilize a combination of Centrex™, business lines, and KTS systems.

The agency has variable demand for intra-agency site-site voice communications, the calling patterns consist primarily of local inbound and outbound and variable levels of inter-LATA toll usage within its regional campus and branch offices. The use of authorization codes is required to initiate a toll call. The agency's sites are currently networked solely via the PSTN from a voice services perspective. The agency has emergency power capabilities as follows: regional campus and branch offices may have UPS capabilities while the headquarters facility has an external power generator.

"Agency B" utilizes multiple desktop phone configurations consisting primarily of analog handsets with the addition of IP-based desktop phones in some

administrative areas. The agency's voice mail requirements are met by a combination of premise-based Centigram™ voice mail systems, PBX-specific systems, and network-based BellSouth voice mail services.

4.2.3 Current Data Network Operating Environment

The wiring infrastructure for the agency's LAN environment consists primarily of CAT5 cable plant with a limited amount of CAT3 wired connections. "Agency B" has deployed a limited number of WLAN access points to date, but is very interested in expanding the use of WLAN access within its facilities. The current LAN switch infrastructure, sourced from Cisco, is on a five (5) year lifecycle and technology refresh plan. The existing switch infrastructure is able to support applications requiring QoS management with approximately twenty-percent (20%) also capable of but do not currently support PoE. The agency utilizes virtual private network (VPN) services to meet its remote access requirements with a limited amount of legacy dial-up modem access which is in process of being retired.

The agency's WAN environment consists of a mixture of frame relay and MPLS connections. "Agency B" is currently migrating its current frame relay service connections to the State of Georgia's new MPLS service. The connection speeds from each site to the MPLS network are expected to vary from 384 Kbps (DSL) to 10 Mbps. The agency utilizes firewall technology at all WAN connection points to protect from unauthorized network access and activity and uses DHCP and network address translation (NAT) techniques to support device IP address management requirements. Lastly, the agency's standard computing (desktop and laptop) environment is based on the Microsoft Windows™ XP operating system and utilizes Microsoft Exchange™ as its standard e-mail system and but supports IBM Lotus Notes™ at one location.

4.2.4 Business Drivers and Requirements

The ideal voice communications solution or solutions for "Agency B" will directly reduce operating costs by directly reducing the cost of connectivity and usage costs. In addition, a new solution should achieve reduced management and support costs. The agency is seeking to improve work flows and reduce operational expenses as the agency anticipates that a significant percentage of its communications infrastructure will approach end-of-life within the next several years. "Agency B" is very interested in expanding the use of wireless technologies across its regional campus and branch office environments and would benefit from the application of dual-mode, public cellular and WLAN-

capable, wireless solutions. The agency operates in an environment that enables it to obtain additional capital expense funding beyond its normal operating funding level for projects whose merits and benefits are tied to reduced operating expenses and whose solutions will improve staff productivity such as web-based video tools for collaborative and consultative applications.

4.3 Customer Profile "Agency C"

4.3.1 Size and Workforce Distribution

The third of four customer profile reference models, "Agency C", has a staff of more than nine-hundred (900) employees distributed across the State of Georgia within a headquarters office, approximately fifteen (15) regional offices and fifteen (15) branch offices, one (1) call center, and one (1) data center facility.

4.3.2 Current Voice Network Operating Environment

The agency's voice network consists of voice "islands" served by a combination of premise-based PBX and KTS systems, LEC-provided Centrex™ services, and LEC-provided flat-rate business line services. "Agency C" utilizes a PBX at its headquarters location with primarily Centrex™ services at its regional and branch office locations. The agency also utilizes automatic call distribution (ACD) systems in conjunction with a PBX to meet its call center voice requirements. The agency's calling patterns consist primarily of local inbound and outbound, high levels of intra-agency site-site usage, and moderate levels of inter-LATA toll usage across its facilities. The agency's sites are currently networked solely via the PSTN from a voice services perspective. The headquarters and approximately fifty-percent (50%) of the regional office facilities have both emergency power generation and UPS capabilities while the remaining fifty-percent (50%) of the regional offices are equipped with UPS equipment.

"Agency C" utilizes multiple phone configurations including proprietary Nortel or BellSouth telephones, platform-specific PBX and KTS handsets, and single-line units. The agency's voice mail requirements are met by a combination of premise-based Centigram™ systems, PBX-specific systems, and network-based LEC-provided voice mail services. In addition to the above-mentioned wireline

solutions, "Agency C" utilizes two-way portable radios under state contract to meet its wireless communications requirements.

4.3.3 Current Data Network and Data Center Operating Environment

The wiring infrastructure for the agency's LAN environment consists primarily of CAT5 cable plant with a limited amount of CAT3 wired connections. "Agency C" has deployed a very limited number of WLAN access points to date, and has not immediate plans to expand this due to security-related concerns. The current LAN switch infrastructure, sourced from 3Com, can support applications which requiring QoS management although none currently support the PoE standard. The switch infrastructure is near its end of it life and is anticipated to require an upgrade or replacement during the next three (3) years.

The agency's WAN environment consists of a mixture of frame relay, SNA, and MPLS connections. "Agency C" is currently migrating its current frame relay service connections to the State of Georgia's new MPLS service with the SNA also targeted for migration to the MPLS service in the future. The connection speeds from each site to the MPLS network are expected to vary from 1.5 Mbps to 10 Mbps. The agency utilizes firewall technology, sourced from Cisco, at all WAN connection points with encryption activated. The agency manages its own data center and maintains a server operation including application and web servers with GTA-provided network monitoring services. Agency "C" utilizes dial-up modem and VPN services for remote access services and maintains its own radius servers for authentication purposes. Lastly, the agency's standard computing (desktop and laptop) environment is based on the Microsoft Windows™ 2000 and XP operating systems and utilizes Microsoft Exchange™ as its standard e-mail system.

4.3.4 Business Drivers and Requirements

The ideal voice communications solution or solutions for "Agency C" will positively impact operating costs by reducing the cost of connectivity and usage (long distance) costs. The agency is seeking improved approaches to operating in support of its mission and anticipates that a converged communications infrastructure will enable it to obtain a cost and efficiency advantage that will be reflected in reduced support costs including technical support desk expenses. In addition, a new solution must be provide secure, reliable communications without exposing the agency's voice and data communications to increased vulnerabilities while providing improved disaster recovery services and extensibility of service and integrated communications to similarly-focused local

agencies. In addition, "Agency C" anticipates it would realize cost benefits as well as increased efficiencies through the use of interactive video applications that would enable its employees to interact with other well-defined third-party and State of Georgia entities without incurring travel time and expenses.

4.4 Customer Profile "Agency D"

4.4.1 Size and Workforce Distribution

The fourth and final customer profile reference model, "Agency D", has a staff of more than five-hundred employees distributed across the State of Georgia. The workforce is distributed in the following facilities: headquarters office (70%), approximately ten (10) regional support offices (25%), one call center, and one data center facility (5%).

4.4.2 Current Voice Network Operating Environment

The agency's voice network consists of isolated voice networks served by LEC-provided Centrex™ services in its headquarters location, Centrex™ services and KTS systems in its regional support offices, and a PBX within its call center. The agency's calling patterns consist primarily of local inbound and outbound, high levels of intra-agency and inter-agency site-site usage. The agency's sites are currently networked solely via the PSTN from a voice services perspective.

"Agency D" utilizes multiple phone configurations including proprietary Nortel or BellSouth telephones, platform-specific PBX and KTS handsets, and single-line units. The agency's voice mail requirements are met by a combination of premise-based Centigram™ systems and network-based LEC-provided voice mail services. In addition to the communications services provided to it facilities statewide, "Agency D" utilizes a combination of state paging, public cellular voice, and handheld wireless data services to meet its wireless communication needs.

4.4.3 Current Data Network and Data Center Operating Environment

The wiring infrastructure for the agency's LAN environment consists primarily of CAT5 cable plant with a limited amount of CAT3 wired connections. The current LAN switch infrastructure, sourced from Cisco, is on a five (5) year

lifecycle and technology refresh plan. The existing switch infrastructure is able to support applications requiring QoS management but is currently unable to support PoE-enabled applications. .

The agency's WAN environment consists of a mixture of frame relay and MPLS connections. "Agency D" is currently migrating its current frame relay service connections to the State of Georgia's new MPLS service. The connection speeds from each site to the MPLS network are expected to vary from 1.5 Mbps to 10 Mbps. The agency utilizes firewall technology at all WAN connection points to protect from unauthorized network access and activity. The agency manages a data center and maintains an application and web server operation. Lastly, the agency's standard computing (desktop and laptop) environment is based on the Microsoft Windows™ XP operating system and utilizes Microsoft Exchange™ as its standard e-mail system.

4.4.4 Business Drivers and Requirements

As with the other customer profiles, this agency is sensitive to managing (and reducing) the operating costs associated with its communications services and systems. The ideal voice communications solution or solutions for "Agency D" will directly reduce operating costs by eliminating the toll charges it incurs for intra-agency and inter-agency usage. The agency is seeking a voice solution that that can serve as a foundation for enhanced services with increased flexibility and value beyond currently deployed solutions. In addition, the solution must reduce the overall cost to operate, manage, and maintain the voice services and systems.

5 Voice Over IP (VoIP) Product Alternatives

The following sections provide an overview of the various "premise-based" and "network-based" voice-over-IP based service alternatives available to the GTA. The primary difference between these service categories is that premise-based solutions must be deployed at each physical service location and have very high operating costs in distributed environments while network-based solutions may be centrally-deployed and are highly cost-effective in distributed environments.

5.1 Premise-Based Solutions

5.1.1 IP-Enabled PBX

The first potential step towards achieving the potential benefits of voice and data convergence is to IP-enable an existing, circuit-switched PBX. Essentially a voice gateway (or voice-enabled router) is deployed between the PSTN and the PBX allowing for the re-routing of site-to-site voice calls across the WAN via VoIP trunks between PBXs. Economic benefits of IP-enabling PBXs may be minimal or non-existent given the relatively low cost per minute of long distance services as well as calling patterns. Agencies which do not have a large number of site-to-site calls may find that the cost of additional bandwidth to support VoIP trunking outweigh any potential cost savings. The majority of the circuit-switched PBXs and KTSs currently deployed across the state agencies are not candidates for this approach and cannot be IP-enabled due to lack of existing vendor support.

5.1.2 Hybrid IP-PBX

The deployment of a hybrid IP-PBX requires the replacement of the existing legacy PBX or KTS and allows the state agencies to retain separate intra-site voice and data networks and migrate to IP-based phone technology in the future. As compared to an IP-enabled circuit-switched PBX, a hybrid IP-PBX phone system provides increased flexibility for integration of the phone system with other IP applications such as unified communications solutions, multi-party conferencing solutions, and advanced contact center and CTI applications.

The hybrid IP-PBX has an integral voice-over-IP gateway, thereby also enabling state agencies to route internal site-site calls over the MPLS-based WAN and achieve toll-bypass savings. Because a hybrid IP-PBX does not require the

deployment of IP-based phone technologies, enterprises typically select this architecture to leverage their existing investment in analog or compatible digital handsets and can choose to migrate to a converged voice and data LAN environment in a phased approach. The hybrid IP-PBX architecture currently has the broadest appeal for new phone system purchases by enterprises and is available from traditional phone system equipment vendors such as Alcatel, Avaya, Ericsson, Nortel, and Siemens. The hybrid IP-PBX architecture provides the most flexibility in supporting analog, digital, and IP-based devices without dictating the need to voice-enable LAN environments. The deployment model for hybrid IP-PBXs can vary from high-distributed designs to centrally hosted and managed designs. The list of enterprise-class system integrators who have embraced the supporting services model for this system architecture include EDS, IBM, and Unisys. The hosted deployment model is a solid fit for the GTA and the state agencies that it serves given its ability to provide distributed services from a centrally managed and maintained core infrastructure at a highly competitive cost per end device.

5.1.3 Pure (IP Only) IP-PBX

The most aggressive approach to the deployment of voice-over-IP based services is through the use of a pure IP-PBX; a voice system that provides (and requires) for full convergence over the WAN as well as the LAN. The deployment of this type of system requires a full "fork-lift" upgrade requiring the replacement of the existing phone system and the enablement of voice-over-IP based services across state agency LAN environments. The advantage of such a system is the immediate and universal availability of converged IP features and functionality, which typically enable more flexible call management and unified messaging solutions than that of hybrid IP-PBXs deployed with non-IP phone devices. Note that a hybrid IP-PBX may be deployed in a pure IP-PBX mode (see vendors listed in previous section) and pure IP-PBXs may be deployed in either a distributed or centrally hosted implementation model.

Again, the pure IP-PBX architecture requires that all LANs are voice-enabled and that legacy voice system elements be fully compatible with the vendor solution unless a complete voice network "forklift" upgrade is intended. Given that neither of these conditions align with the GTA's practical operating environment and that the operational complexities of supporting distributed PBXs is inconsistent with the stated objective of reducing operational costs, this system approach is not a feasible alternative for the GTA.

5.2 Public, Network-Based Services

5.2.1 Hosted IP-PBX Services

The maturation of voice-over-IP technology has attracted numerous service providers to offer full-featured, hosted IP-PBX service solutions. The solutions combine the broad feature set of an enterprise-class, premise-based IP-PBX with the attractiveness of a network-based service which includes integrated high-speed Internet access services. The key to operational success in a hosted IP-PBX architecture is the ability to assure and deliver high availability across the WAN to all end points. The primary advantage to this product strategy is the ability to integrate voice and Internet access services over the same local loop connection. The target market for hosted IP-PBX services are primarily focused today on the small and medium business (SMB) market segment versus enterprise-class solutions and are dominated by numerous startup service providers. In addition, these services are typically available only within large metropolitan service areas and therefore would be unable to adequately overlap with the agency's local access and phone number requirements.

5.2.2 IP Centrex Services

The market has recently experienced a surge of startup service providers as well as traditional providers of telecommunications services offering "IP Centrex" services, in which all call control or call management services, as well as media gateways to the PSTN, are hosted and delivered by the service provider in conjunction with the deployment of IP desktop phones (does not retain support for analog handsets). The network implementation employed by the service provider may vary from a hosted, server-based application model to a packet gateway front-end connected to a traditional, circuit-switched 5ESS or DMS-100 voice switch. The services are typically managed by accessing a web portal that allows customers to configure features for individuals or groups of users.

The majority of "IP Centrex™" services currently lack the breadth of features commonly found in IP-PBX solutions and are currently available as regional or nationwide services in large markets, though service offerings are rapidly expanding in both feature richness and geographic coverage. In addition, a long-term product-related issue associated with pursuing an IP Centrex-based voice strategy that requires the use of multiple local exchange carrier (LEC) networks is that it is improbable that agencies would be able to achieve a consistent user interface (system menus, web-based management, etc.) across state-wide locations (e.g. desktop phones functions may be activated differently from

location to location). More importantly, it is highly doubtful that GTA will have access to an IP Centrex service with local points of presence throughout the state, most services have only major metropolitan areas in their product plans at this time.

6 Network Considerations and Best Practices

Based on the specific requirements to support voice & data convergence, Burton Group recommends that the GTA review and implement the following technical positions into its enterprise network architecture guidelines for all agencies. Each technical position provides a baseline standard for technology deployment based on industry best practices and Burton Group's knowledge as formed by its interactions with enterprise and service provider clients and industry solution providers. The application of these recommendations will prepare the agency enterprise networks to successfully VoIP-based technologies and support voice and data network convergence.

6.1 Local Area Networks

The following sections define the network architectural standards required to enable support for IP telephony within LAN environments throughout the various state agencies.

6.1.1 Power over Ethernet (PoE) - Statement of Position

Only Ethernet switches capable of supporting IEEE 802.3af Power over Ethernet standard shall be procured

In IPT environments, the LAN takes on many of the features that were formerly part of the traditional, circuit-switched PBX. Ethernet LANs are expected to provide reliable and survivable line power for IP phones, user location information for emergency services, and access control for security services. In addition, it should be noted that industry best practices for the deployment of WLAN access include leveraging power over LAN switch infrastructure to simplify the installation and wiring costs of deploying WLAN access points. The use of PoE-enabled edge LAN switches or midspan power insertion devices in conjunction with UPS power units in a secure wiring closet environment can effectively replicate the availability and reliability of the traditional PBX to desktop IP phone connection.

The agencies included in the previous customer profiles have a limited number edge LAN switches which support the 802.3af PoE standard in their current configuration. Burton Group recommends that each agency, in conjunction with

the GTA product management team, establish a migration plan for its existing edge LAN switch infrastructure as an architectural element to deliver maximum system availability for both IPT and WLAN access applications and users. The agencies should account for the additional heat dissipation associated with each of its selected PoE solution during the design and deployment of a PoE-enabled LAN switch upgrade. Burton Group recommends that all future purchases of edge switches by state agencies support PoE to readily enable its future IPT and WLAN deployments.

In an effort to defer or distribute the upgrade costs associated with migrating to a PoE-enabled LAN environment, Burton Group recommends that the state agencies evaluate migrating in two phases. In the first phase of this migration, desktop IP phones may be powered by local AC outlet connections with or without backup UPS power to both edge LAN switches and desktop IP phones. With this approach, each state agency must evaluate the cost/benefit of providing UPS versus the use of alternative communications (cell phone) in the event of a local power outage. The second phase of this approach would include the implementation of the PoE upgrade to the LAN switches and the associated re-deployment of any UPS units to other non-PoE-enabled sites. Burton Group recognizes that this approach may not be desirable or practical for all locations; but for those locations where, in the event of a power loss, voice services are not mission critical this represents an alternative to spread the upgrade costs and associated activities over an interval of time while investing in IP phone devices.

6.1.2 Logical LANs - Statement of Position

Use Virtual LANs (IEEE 802.1p/Q) and Virtual LAN trunking to logically isolate VoIP signaling and bearer traffic for desktop IP phones

In IPT environments, industry best practices dictate that virtual LANs (VLANs) should be used for the logical separation of voice and data traffic across the LAN. The separation of the voice and data segments prevents devices on the data VLAN from capturing or listening to calls on the voice VLAN. In addition to the management and security benefits associated with traffic separation, VLANs can provide for the prioritization of voice traffic in a LAN environment. Since voice is generally considered mission-critical, the use of VLANs can effectively protect voice resources (communication servers, media and PSTN gateways, IP phones) from being hacked, and can prevent any denial-of-service attacks that would potentially disable voice services. The approach of using VLANs to isolate VoIP from data traffic is only applicable where stand-alone desktop phones are used. If PC-based softphones are deployed, they can not be logically separated unless

the edge switch is capable of detecting and routing IPT signaling and media traffic. This typically requires the use of edge routers capable of identifying and classifying packets based on IP header information.

Based on the information shared with Burton Group during this project, the majority of state agencies can support VLANs within its current LAN environment. Burton Group recommends that state agencies activate the VLAN capability within its current edge switches on all effected LAN segments associated with the deployment of IP phones and assign the highest 802.1q VLAN identification value for both voice bearer and signaling traffic to provide prioritization based on VLAN ID.

6.1.3 LAN Quality of Service - Statement of Position

Prioritize VoIP in the LAN using IEEE 802.1p and in the WAN using DiffServ and Class-Based Weighted Fair Queing

One of the primary concerns of enterprise users when migrating from a circuit-switched voice network to an IPT environment is voice or audio quality. As the vast majority of enterprises have not implemented any significant form of quality of service (QoS) prior to IPT deployments, traffic may experience varying amounts of packet loss, delay, and jitter. The impacts of this may be experienced by users as audio breakup, clipping, or "pops" or "clicks" in the audio stream. The industry best practices for QoS outline the use of Layer 2 and Layer 3 mechanisms to support voice applications on a converged network. The previous statement of position on logical LANs specified the use of 802.1q-based VLANs and how the VLAN ID may be used to prioritize voice bearer and signaling traffic in a LAN environment. The concept of QoS must be extended from the LAN environment to include all routers and switches that voice traffic be traverse. The application of Differentiated Services (diffServ) across these network elements enables network engineers to define multiple QoS behaviors on a per-hop basis to ensure that users experience a consistent, high-quality audio experience. DiffServ is only a packet marketing protocol, the actual prioritization of packets is performed in routers using an algorithm called Class-Based Weighted Fair Queing (CBWFQ) which prioritizes packets received based on DiffServ markings. In all Cisco environments, a proprietary Cisco QoS enformcement approach known as "Low Latency Queing" or LLQ, may be used. LLQ provides a greater level of assured performance than CBWFQ, but in severe congestion instances may cause the blockage of all low priority traffic.

In addition to CBWFQ and LLQ, all routers should have weighted random early detection (WRED) capabilities enabled. This feature common across most router

platforms enables the routers to randomly slow down low priority sessions in times of increasing congestion, thus protecting the performance of sensitive applications such as voice.

Based on the information shared with Burton Group during this project, the majority of state agencies can support LAN QoS on its existing switch infrastructure. Burton Group recommends that state agencies use QoS mechanisms to prioritize voice performance in all edge switches, core switches, and enterprise routers utilizing the 802.1q and DiffServ mechanisms described above.

6.1.4 Wireless LANs – Statement of Position

"**IF** any device will require wireless LAN access
THEN utilize 802.11a/g/h compatible access points
OTHERWISE no wireless LAN access is required"

In IPT environments, industry best practices for wireless local area networks (WLANs) are currently under revision. The emergence of voice over WLAN solutions is driving requirements for higher access point (AP) channel densities. The 802.11a standard provides up to 24 non-overlapping channels, expanding the number of available channels per access point eight-fold and simplifying the deployment of the AP network.

Based on information shared with Burton Group during this project, the agencies have deployed a limited number of 802.1b-compatible access points. Although the use of WLAN technology within the agencies has been limited in the past, interest was expressed during the project on the desired expansion and availability of WLAN access to meet user's mobility preferences and associated requirements, especially in the regional office and campus environments. Burton Group recommends that in locations and situations that require that WLAN technology be deployed, the agencies deploy 802.11a/g/h-compatible APs and wireless network interface cards (NICs). Since 802.11g provides backwards compatibility with 802.11b, supporting 802.11g provides the capability of connecting with stations using either of these ubiquitous standards (802.11b or 802.11g) for current use within the agency's enterprise networks (802.11b) or wireless hotspots (802.11b or 802.11g).

6.2 Metropolitan and Wide Area Networks

6.2.1 WAN Quality of Service - Statement of Position

"**IF** real-time applications will be transported over the WAN
THEN utilize MPLS network services

In VoIP and IPT environments, ensuring WAN QoS is critical to sustaining the results achieved through LAN QoS management. The current migration to new MPLS network services is the current state-of-art network technology to ensure end-to-end QoS. Burton Group recommends, if not currently in place, that the GTA document the performance level guarantees for packet delay and jitter that the public MPLS services can reliably support and compare and confirm that these values are within industry best practices (one-way packet delay < 150 msec, jitter <20 msec for toll-quality voice) for VoIP and IPT applications. In addition, industry best practices for the deployment of call management servers suggest that these critical voice network components be deployed with multiple, redundant, WAN connections provided in carrier-class environments with diverse geographic routing.

6.3 Phone Devices – Statement of Position

This section describes the rationale for the use of IP telephones across locations.

Use IP phones where local area network services can support VoIP requirements. Otherwise, use analog phones with analog-to-VoIP gateways

Use wireless IP phones only where specifically required and where their use can be supported by WLAN infrastructure

The strategy to deploy a hybrid IP-PBX architecture enables state agencies to deploy either traditional analog or digital handsets, IP desktop handsets, IP soft phones, or wireless IP phones given the constraints of each local LAN or WLAN access environment, the capital costs associated with preparing each local LAN environment for IPT (refer to section 5.2.1). The primary advantage for enterprises to migrate to IPT via a hybrid IP-PBX architecture is the ability to transition to a fully converged network over multiple years while reducing the initial capital investment for new handsets, i.e. leveraging existing compatible phones and interface cards and deferring the expense of upgrading the LAN until the business value of IP to the desktop can be realized. With the current

price point of feature-equivalent digital and IP desktop handsets at the same level, new handset investments are typically limited to IP phone devices and are coordinated with LAN technology refresh cycles. The product roadmap for all enterprise-class IP-PBX vendors continues to place increasing emphasis on the IP-enabled phone devices, IP desktop phones, IP soft phones, and wireless IP phones. The incremental advantages of voice and data convergence and the feature functions available in the handsets can be characterized as marginal today but will be more apparent and visible in the next 12-24 months given this investment focus from equipment vendors.

Given the high level of interest in solutions that support mobility that was expressed by some agencies during the project, Burton Group recommends that the GTA conduct a pilot of softphone technology. The softphone solution may be a solid solution for "road warrior" professionals as well as agency staff that frequently work from multiple office locations but that still require a desktop phone at their primary work location, keeping in mind that soft phones are susceptible to the same security vulnerabilities of the laptop devices themselves.

With the potential expanded use of WLAN technology within some agencies, the use of WLAN and dual mode (WLAN and public cellular) IP phones should be studied within the next 12-24 months. Burton Group recommends that the GTA follow the future development of these offerings as they support 802.11a and the WLAN QoS standard (802.11e) currently under development.

6.4 IP Address Assignment

"**IF** VoIP connections must be extended to external entities
THEN utilize public address space for IP phones
OTHERWISE utilize private address space for IP phones
AND assign static addresses to media servers and gateways
AND utilize separate DHCP servers for voice and data segments"

The decision on whether to use public or private address space for IP phones is driven simply today by whether an enterprise has a business need to directly connect its VoIP network to external entities such as trading partners or affiliate operating companies outside of the enterprise's IP address space. Based on the information shared with Burton Group during this project, the state agencies generally do not currently have a need to connect its future voice network directly with external business entities. Burton Group therefore recommends

that state agencies and the GTA exclusively utilize private address assignments for all its IP-based voice platform components at this time including IP phones. The benefit of such an approach is that external hackers will not be able to scan the voice address segment for security vulnerabilities. Alternatively, the state agencies and the GTA could utilize a proxy device that can support network address translation (NAT) translation and also function as a stateful firewall and content filter. The devices known as "session border controllers" currently fill this void, although in the future it is expected that much of the this functionality will be migrated directly into enterprise gateways and firewalls as the SIP standard continues to fully develop.

In addition, Burton Group recommends that state agencies utilize separate DHCP servers for the voice and data segments operating with separate address space for security reasons, specifically to prevent a denial of service (DoS) attack against the data segment DHCP from affecting allocated IP phone addresses. In addition, Burton Group recommends that the agencies utilize primary and secondary DHCP servers to ensure highly available DHCP services.

6.5 Site-Site Trunking

The use of the WAN to interconnect IP-enabled and/or IP-PBXs, referred to as IP trunking, is an effective approach to improve bandwidth utilization across WANs and to redirect any site-site voice communications which do not currently utilize the WAN but rather the PSTN. In most cases, the use of site-site PBX trunking will result in a low to moderate reduction of voice service costs. Note that IP trunking is an inherent feature of today's IP-based voice platforms.

6.6 PSTN Trunking

As with traditional PBXs, IP PBXs need to connect directly to the PSTN in order to accept and initiate calls to phone numbers external to the enterprise. In an IPT environment, where call control is handled by a limited number of call management servers, the gateway connections to the PSTN may be centralized much in the same way that Internet connectivity is centralized to several hub locations, thereby saving on the capital and direct operational costs associated with gateways and PSTN connections. However, local PSTN connectivity may be required for inbound calls to avoid long-distance rates for callers. Burton Group recommends that state agencies trunk directly to the PSTN at all local sites. In most cases, all sites will need local telephony access for emergencies, for

low-cost local calling, and to receive local calls directly without imposing long distance charges on any inbound calls utilizing local versus toll-free access.

In the future, an emerging new class of services from carriers such as Level 3, Global Crossing, and Broadwing will allow the elimination of traditional (T-1) switched local access to the PSTN. The services would enable state agencies to establish an IP trunk to the carrier to link to the PSTN, potentially offering large cost savings when compared to the number of dedicated T-1s required at most medium to large locations. Burton Group recommends that the GTA pursue and employ these services in their future VoIP and IPT strategy as they become commercially available.

6.7 VoIP and IPT Security

With the convergence of voice and data networks, voice which has traditionally been a "closed" system, is exposed to all of the threats faced by data networks including viruses, Trojan horses, and denial of service (DoS) attacks. The mitigation of these attacks requires special attention. As discussed in section 5.2.1, voice and data networks should be isolated on a logical basis as much as possible, with firewalls and intrusion detection deployed at connection points. Every effort must be made to ensure that attacks on the data network are not allowed to cross over to the voice network or conversely from the voice segment to the data segment. In addition, IPT faces threats from rogue phone usage and illicit capturing of phone conversations. Burton Group recommends the GTA establish a implementation standard based on the following industry best practices: (1) separate voice and data segments by the use of VLANs (refer to section 5.2.1), (2) utilize separate DHCP servers for voice and data IP address assignment, (3) continue to utilize firewalls and intrusion detection and prevention systems (IDPS) at all voice and data interconnection points, (4) utilize host-based IDPS for all call management servers, (5) verify and validate both user and device network access utilizing 802.1x authentication mechanisms and (6) deploy encryption of signaling and media traffic where warranted.

6.8 VoIP and IPT Management

The need to support VoIP and IPT in the enterprise transforms today's network managers into application performance managers and telephony managers into data networking managers. Simply managing for uptime and utilization is no longer sufficient. In order to insure the acceptable performance of VoIP/IPT, network managers must be capable of monitoring call flow patterns including end-to-end performance from phone to phone, phones to call manager/proxy, and ideally from phones to and from the PSTN. All enterprise-class IP-PBX vendors now offer robust management solutions, either directly or via partnerships, which provide administration, configuration, performance, and fault management applications for their communication servers and media gateways. Burton Group recommends that state agencies deploy (or maintain) these management applications in conjunction with their deployment of IP-based voice platforms and IP phone devices and align this effort with identity and access management strategies.

Although not directly related to VoIP and IPT management, the deployment of IP phones will directly increase the number of devices under management by agency IP address management tools. The addition of IP phone devices will directly impact the total number of licenses required for this solution and this incremental cost should be factored into the cost analysis and justification associated with IP-enabling agency LAN environments.

Lastly, the proactive monitoring of voice QoS throughout a pilot and first thirty to sixty days following a migration to IPT follows current industry best practice. The tools to perform this important monitoring and management function have been slow to develop but have been announced over the last twelve months. Burton Group recommends that the GTA evaluate these solutions and deploy a QoS management system as a component of its VoIP strategy.

7 Product Strategy Recommendation

The GTA must support a regionally distributed customer base with its new voice-over-IP product and provide service at an attractive cost per line in order to effectively position its new service against the current legacy voice services in use. The premise-based solutions used by the state agencies vary significantly in their life cycle stage, therefore it is reasonable to assume that any new voice service will have an extended migration timeline, a reasonable assumption is that the product migration will occur over a ten (10) year period. In an effort to minimize capital, operational, and maintenance costs, Burton Group recommends that the GTA adopt a voice product strategy based on a hybrid IP-PBX system architecture implemented within a centrally or regionally hosted deployment model. A hybrid IP-PBX environment, either owned or outsourced, can enable the GTA to provide its voice-over-IP-based services with the use of either analog, digital, or IP phone devices, and supports the optional convergence of LAN environments as deemed appropriate by each individual state agency. The implementation of a hosted deployment model will enable agencies to obtain the economic benefits of a network-based solution and avoid the operational costs and complexities of geographically-dispersed, premise-based solutions. Without the dependency to migrate to IP phones, each agency can independently evaluate the capital impacts and requirements for migrating to a converged LAN environment and therefore choose from analog, digital, or IP phone devices.

In addition, Burton Group recommends that the GTA require that any solution either currently support or have an acceptable product roadmap to support the use of Session Initiation Protocol (SIP) for trunking and end-device signaling. The use of SIP will provide additional flexibility in system deployment and may allow the use of components from multiple vendors, thus reducing system costs. Given that most vendors of voice-over-IP equipment have committed to the SIP standard, the GTA should request specific release dates from any vendors which do not currently fully support the SIP standard for all end-device communications. A successful implementation of a hosted IP-PBX deployment model is highly dependent on implementing a network capable of providing acceptable reliability, security, and performance. The GTA's recent deployment of MPLS-based network services are well-suited to provide the necessary WAN connectivity to provide a geographically distributed solution to the state agencies.

The purpose of the product strategy is not to define the specific implementation path that the GTA may execute, but it should be highlighted and noted that the strategy may be implemented using one of multiple approaches: the solution

may be hosted and managed by the GTA at its secure, data center facility, hosted by the GTA and managed by a third-party (e.g. IBM or EDS), or hosted and managed by a third-party at a co-location or data center facility. Note that if the solution is hosted at a third-party facility, a quality-of-service (QoS) enabled network connection between the third-party facility and the MPLS-based WAN will be required.

The migration from the current agency voice environments to the new product strategy will be determined by different triggers for different agencies, the first of which will be new facility construction. Within the process of adding a new facility to an agency's operation, the communications environment should be specified and constructed to support the requirements described in Section 6 of this document. The typical elements required will include minimum CAT5 cabling infrastructure, QoS and PoE-capable LAN switches, and gateway routers.

The next "user" scenario that will lead to a migration is those agency locations which have decided to use a non-PSTN voice solution to meet their voice services needs, i.e. the agency is considering the deployment of a PBX for call center or ACD functionality or a KTS for its enhanced functionality beyond Centrex™ services. The next target for these new services will be those agency locations with existing legacy PBX and KTS systems that are nearing the end of their life cycle as well as those locations that have a high volume of intra-agency usage.

Closely following the previous user scenarios, the requirements that can best be met with the new product strategy will be those agencies have a critical or growing requirements for increased mobility in order to better serve their agency constituents. In addition, those agencies with a growing requirement for supporting tele-worker application environments (or virtual call center agents) will led the migration from an application perspective. The implementation of video-based applications and enhanced communications applications such as instant messaging platforms, presence-based tools will be enabled by a VoIP-based (and more so specifically by IPT-based) infrastructure and will create the tipping point for the application-oriented agencies. The use of these technologies will improve the efficiency and operations of these agencies and will therefore provide applications value that will encourage migration.

The remaining addressable market, traditional Centrex™ users with basic feature and function requirements, will migrate based on operational cost reductions due to lower monthly recurring costs and the phased elimination of peripheral cost impacts such as LAN upgrades due to other project initiatives. The migration of this last profile of customers will rely heavily on the future LEC

pricing for legacy Centrex™ services, the future pricing will be influenced by several factors: (1) the continued erosion of the traditional Centrex™ customer base and (2) the long-term migration of LEC voice networks from the current circuit-switched networks to tomorrow's IP-based, softswitch technologies

The GTA should leverage the execution of its new voice strategy for improved pricing from both the vendor(s) of the new strategy as well as the LECs. Burton Group would expect the hybrid IP-PBX vendor(s) and associated managed service providers to be more aggressive than the LECs as the LECs must concern themselves with the forward product and price positioning of their own future IP Centrex™ service offerings.

In an effort to fully understand the economic impacts of implementing this product strategy, the next step of this project will have principle focus on the development of a total cost of ownership (TCO) model for each profile and from a GTA perspective. The TCO model will establish assumptions for the impacts on network components, WAN bandwidth and PSTN trunks, LAN upgrades, support staff, etc. that may be verified and rationalized prior to and at the conclusion of the vendor request for proposal (RFP) phase of this project.

8 Product Strategy Risk Assessment

The direction with which the GTA pursues relative to its future voice strategy is not without risk. The first risk to consider before examining the risks of the new product strategy is the risk of not pursuing a different direction. The agencies which are served by the GTA utilize infrastructure which spans the equipment life cycle range and therefore will increasingly require a technology refresh or full replacement. In addition, with the proliferation of voice-over-IP based voice solutions from the vendor community, individual agencies and locations within the agencies will increasingly select and request different solutions which will correspond to higher communications operating costs for the State of Georgia as a whole. The situation requires a new strategy given the shift in technology and overall voice technology refresh cycle that the agencies are increasingly entering.

The product strategy recommended in the Section 7 is not without risk though, as a shift to any product or set of products represents change and therefore risk. The underlying technology for voice-over-IP-based solutions has matured during the last twelve (12) to eighteen (18) months and is commonly being deployed in large enterprise environments. In parallel to this technology maturation, the architectural approach to deploy a solution in a centrally or regionally-managed environment has been widely-accepted as a best-practice for today's solutions.

The risks associated with the recommended product strategy are two-fold: the number of potential end-users is unparalleled in current deployments but is certainly within the scalability levels designed into the platforms. The level of risk associated with this concern is relatively low as the end-users are divided into separate "communities of interest" and therefore will not require a single system image and its individual image is well within current scaling limits set by large enterprises. The second risk is the reliance on the MPLS-based "data" network to provide a highly reliable and available service to the breadth of end-users which are widely distributed. The risk could mitigated by a regionalized deployment approach but this will also negatively impact the operating cost efficiencies associated with a centrally-hosted solution model and a regional deployment model will still be susceptible to perhaps the highest probability of network failure, the local loop. The most feasible approach to this risk may be the collocation of redundant call management servers at locations which require the highest levels of availability.

Appendix A. Customer Profile Summary

Business Requirement	A	B	C	D	IP-Enabled PBX	Hybrid IP-PBX	IP-Only IP-PBX	Hosted IP-PBX	LEC IP Centrex
1. Scalability (Small)	H	H	H	M	N	Y	N	Y	Y
2. Scalability (Large)	H	H	H	H	Y	Y	Y	N	Y
3. Survivability	H	H	H	H	Y	Y	Y	Y	Y
4. Security	H	M	H	M	Y	Y	Y	Y	Y
5. Mobility Support	M	H	L	H	N	Y	Y	Y	Y
6. Tele-Worker Support	M	H	L	M	N	Y	Y	Y	Y
7. Call Center Support	H	L	L	L	N	Y	N	N	N
8. Application Integration	H	L	M	M	N	Y	Y	Y	N
9. Phone Device Flexibility	H	H	H	H	N	Y	N	Y	N
10. Support Cost Model (Low)	H	H	H	H	N	Y	N	Y	Y
11. LAN Covergence/Upgrades	L	L	L	L	N	Flexible	Y	Flexible	Y
12. Extensibility - Local Government	L	L	H	L	N	Flexible	N	N	N
Current Operating Environment									
1. Centrex	H	M	M	H					
2. Premise-Based PBX	L	M	M	L					
3. Premise-Based KTS	L	L	H	M					
4. VoIP Enabled LANs	N*	Y*	Y*	Y*					
5. Inter-LATA Toll Usage	H	H	H	H					
6. Site-Site Intra-Agency Usage	L	M	H	H					

H = High Requirement
M = Medium Requirement
L = Low Requirement

Y = Well Supported
N = Not Well Supported
Y*/N* = Flexible Support or Not Required